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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/058,426	01/30/2002	Daisuke Komada	020060	4298
38834	7590	04/01/2004	EXAMINER	
WESTERMAN, HATTORI, DANIELS & ADRIAN, LLP 1250 CONNECTICUT AVENUE, NW SUITE 700 WASHINGTON, DC 20036			BARRECA, NICOLE M	
			ART UNIT	PAPER NUMBER
			1756	

DATE MAILED: 04/01/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/058,426	KOMADA ET AL.	
	Examiner	Art Unit	
	Nicole M. Barreca	1756	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 26 January 2004.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-10, 13 and 14 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-10, 13 and 14 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 26 January 2004 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| Paper No(s)/Mail Date <u>1/26/04</u> . | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

1. Claims 1-10 and 13-14 are pending in this application.
2. Fig. 10F and 10G and postcard filing receipt were received and the drawing objection is withdrawn.
3. The 35 USC 112, second paragraph rejection of claims 9 and 10 is withdrawn in response to the applicant's amendment.
4. The claims recite forming a film made of "hydrogenated silicon carbide". While there are many definitions of "hydrogenated silicon carbide" used in the prior art, the applicant describes "hydrogenated silicon carbide" in the specification as silicon carbide which contains hydrogen (p.17) and this is the definition used by the examiner.

Claim Objections

5. Claims 13 and 14 are objected to because of the following informalities: claim 13 recites "the second first film of silicon carbide" and claim 13 recites "wherein the second film is made of fluorosilicate glass". The examiner assumes that since these claims depend on claim 1, that claim 13 was meant to refer to the second film of silicon carbide and claim 14 was intended to refer to the first film. Appropriate correction is required.

Claim Rejections - 35 USC § 102

6. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

7. Claim 1 is rejected under 35 U.S.C. 102(b) as being anticipated by Olsen (EP 926 715).

8. Olsen discloses a fabrication method for an integrated circuit. An oxide layer and/or a thin dielectric layer, such as silicon nitride (applicant's first film being made of a material having a different etch resistance from SiC), is formed on a semiconductor wafer. This is followed by the deposition of a silicon carbide layer (applicant's second film). The silicon carbide layer is deposited using hydrogen containing sources gases, such as silane/methane or trimethylsilane, and is therefore hydrogenated. A photoresist is deposited and patterned. The silicon carbide and other underlying layers are etched [00115]-[0016]. The fifth embodiment teaches etching the SiC layer using NF₃/CHF₃/CF₄/Ar/O₂/H₂ [0026].

Claim Rejections - 35 USC § 103

9. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

10. Claims 1, 2, 5, 7, 9 and 14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Li (US 2002/0173322).

11. Li discloses a method for plasma etching of silicon carbide with selectivity to an underlying and/or overlying dielectric layer (abstract). The silicon carbide may be hydrogenated [0019]. The preferred etching recipe comprises a fluorocarbon gas of CH₃F, with O₂ and Ar. The etching rate of the silicon carbide layer can be further

Art Unit: 1756

increased by adding another F-containing gas such as NF₃ to the CH₃F [0053].

Substrate 42 is a silicon wafer which may include metallization (conductive member on insulating substrate) which is not shown. Photoresist 32 is patterned with opening 30 and overlies a stack of layers. Mask 33 of silicon dioxide, silicon nitride, or silicon carbide (applicant's third film of SiC), first low-k dielectric layer 34 (applicant's second film of insulating material having a different etching resistance from SiC), a first etch stop layer 36 of silicon nitride or silicon carbide (applicant's first film of SiC), a second low-k dielectric layer 38, a second etch stop layer 40 of silicon nitride or silicon carbide are deposited over the substrate. Figure 2B illustrates the structure after etching wherein opening 30 extends through layer 33 (etching third film using resist mask) and layer 34 (etching second film using resist mask). Figure 2C illustrates the structure after repatterning for via 44. Figure 2D shows the structure after further etching, including layers 34, 36 (etching first, second films). See [0045]. Examples of materials for the low-k dielectric layer include fluorinated silicon oxide (FSG), silicate glasses such as boron phosphate silicate glass (BPSG), fluorinated silicate glass and phosphate silicate glass (PSG), carbon doped silicate glass, silsequioxane glass and organic polymer materials [0047]. The dual damascene recess is then typically filled with a liner (barrier), followed by a conductive material [0012].

Li does not disclose that the etching rate of the second film is faster than the etching rate of the first film as recited in claim 7. However Li does teach that the first film (36) is an etch stop layer (i.e. the etching of the second film (34) continues until the first film (36) is reached, as illustrated in Fig.2B). It would have been obvious to one of

Art Unit: 1756

ordinary skill in the art that the etching rate of the second film was faster than the etching rate of the first film because Li teaches that the first film is an etch stop layer and it is known in the art that the etching rate of an insulating layer (second film) is faster than its etch stop layer (first layer). Li does not explicitly disclose that the resist film is ashed and removed. Li does teach that in Fig.2C the structure is repatterned. It would have been obvious to one of ordinary skill in the art that the photoresist layer in the method of Li was removed because Li teaches that the structure is repatterned and it is known in the art that the original patterned resist layer is removed before the second patterned resist layer can be formed.

12. Claims 3 and 4 are rejected under 35 U.S.C. 103(a) as being unpatentable over Li as applied to claim 2 above, and further in view of Bajaj (US 6,261,157).

13. Li is silent on the material used for the conductive region and the barrier layer and does not disclose that the conductive region is copper wiring and the barrier layer is Ta, TaN, Ti and TiN. Bajaj teaches that in a typical semiconductor device the conductive layer is formed by depositing copper, while the barrier layer is formed by depositing tantalum (col.6, 54-63). It would have been obvious to one of ordinary skill in the art to have the conductive region be formed of copper and to have the barrier layer be formed of Ta in the method of Li because Baja teaches that in a typical semiconductor device the conductive layer is formed by depositing copper, while the barrier layer is formed by depositing tantalum.

14. Claims 6, 8, 10 and 13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Li as applied to claims 1, 2, 7, or 9 respectively, above, and further in view of Dabbaugh (US 6,362,094).

15. Li is silent on the conditions for the deposition of the hydrogenated silicon carbide layer and does not disclose that the silicon carbide film is deposited by CVD using tetramethylsilane and carbon dioxide in a flow rate ratio of 0.2 to 0.6. Dabbaugh teaches semiconductor manufacturing method using hydrogenated silicon carbide. Dabbaugh teaches that the hydrogenated silicon carbide layer may be conventionally formed by plasma enhanced CVD using a silane source and an oxygen source. Tetramethylsilane may be used as the silane source, while carbon dioxide layer be used for the oxygen source (col.3, 47-67). It would have been obvious to one of ordinary skill in the art to deposit the hydrogenated silicon carbide layer by CVD using tetramethylsilane and carbon dioxide because Dabbaugh teaches that this a known method for deposition of hydrogenated silicon carbide. Dabbaugh is silent on the flow rates of the source gases and does not disclose that the tetramethylsilane and the carbon dioxide flow rates are in a ratio of 0.2 to 0.6. Source gas flow rates are known in the art to be result-effective variables. It would be within the ordinary skill of one in the art to determine the optimal flow rates ratio for the tetramethylsilane and carbon dioxide in the of method Li in view of Dabbaugh by routine experimentation and to have the ratio be 0.2 to 0.6, if required, because source gas flow rates are result-effective variables and the discovery of an optimum value of a result effective variable is ordinary

Art Unit: 1756

within the skill of the art, as taught by *In re Boesch* (617 F.2d 272, 205 USPQ 215 (CCPA 1980)).

Response to Arguments

16. Applicant's arguments filed 1/26/04 have been fully considered but they are not persuasive. With respect to claim 1 the applicant argues that Olsen does not teach or suggest that the first film is etched using the second film as a mask. Olsen teaches a silicon carbide film (second film) overlying a first film (of oxide and/or nitride). The resist is patterned and then used to etch the underlying silicon carbide, optional nitride, oxide and silicon layers. Since the top film is the SiC, it will be etched first, followed by etching of the underlying layers of nitride, oxide and silicon. Therefore the first film is etched using the overlying, now patterned SiC second film as a mask.

17. With respect to the remaining independent claims, the applicant argues, on the top of p.11, that Lin does not indicate that the resist film is removed between the step of etching of the second film to form a recess and partially expose the first film and the step of dry etching the first film using the gas mixture of fluorocarbon gas and one of SF6 and NF3. In response to applicant's argument that the references fail to show certain features of applicant's invention, it is noted that the features upon which applicant relies (i.e., removing the resist film between these two etching steps) are not recited in the rejected claim(s). Although the claims are interpreted in light of the specification, limitations from the specification are not read into the claims. See *In re Van Geuns*, 988 F.2d 1181, 26 USPQ2d 1057 (Fed. Cir. 1993). The applicant's claims

as written do not have any language limiting the recited steps to any specific sequential order.

Conclusion

18. Applicant's amendment (specifically with respect to new cl.13,14) necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

19. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Nicole M. Barreca whose telephone number is 571-272-1378. The examiner can normally be reached on Monday-Thursday (8:00 am-6:30 pm).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mark Huff can be reached on 571-272-1385. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Art Unit: 1756

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Nicole M. Barreca
Examiner
Art Unit 1756

A handwritten signature in black ink, appearing to read "Nicole M. Barreca", written in a cursive style.

3/24/04